Claims

[c1] 1. A method for operating an X-ray source comprising:
emitting an electron beam along a beam path from a cathode;
producing a dipole field with a differentially biased cathode and interacting said electron beam with said dipole field and said differential bias to focus and deflect said electron beam onto a focal spot on an anode to cause X-rays to be emitted from said anode; and
modifying said dipole field with a means for changing the differential bias to shape said electron beam on said anode to effect the focal spot size to produce a predetermined electron beam compression ratio.

[c2] 2. The method as claimed in claim 1 comprising selecting said predetermined electron beam compression ratio from among a plurality of settable ratios.

[c3] 3. The method as claimed in claim 1 wherein said modifying said dipole field with a means for changing the differential bias comprises modifying said dipole field with an independent bias applied to the components of the cathode.

[c4] 4.The method as claimed in claim 3 wherein said components of the cathode include a backing with a bias of Vbacking, an emitter with a bias of Vemitter, and an aperture defined by a cathode front member with a bias of Vaperture.

[c5] 5.The method as claimed in claim 4 wherein Vback < Vemitter provides for a larger beam compression ratio than when Vback ≥ Vemitter.

[c6] 6.The method as claimed in claim 5 wherein gridding is accomplished when Vemitter > Vaperture.

[c7] 7.The method as claimed in claim 3 wherein a differential voltage between Vbacking and Vaperture is less than about 10kV.

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[c8] 8.The method as claimed in claim 7 wherein the dipole field between said cathode and anode has a beam potential of about 30kV to about 120kV.
(Remark: 30 kV includes mammography applications)

[c9] 9.The method as claimed in claim 1 further comprising providing a larger

emissive area to increase the electron emission.

[c10] 10.The method as claimed in claim 9 wherein said providing a larger emissive area includes at least one of a straight section into a coiled filament, increasing the length of said coiled filament and increasing the diameter of said coiled filament.

[c11] 11.The method as claimed in claim 1, wherein said focal spot area includes a diameter in the range of about 0.1 mm to about 2 mm. (Remark: 0.1 mm for mammo up to 2 mm for CT)

[c12] 12.A method to focus high beam currents of electron emission in a cathode assembly opposing an anode and spaced apart therefrom into different sized focal spots in an x-ray tube, the method comprising:
biasing components of the cathode assembly independently, wherein the components include;
an emitter situated therein for emitting an electron beam to a focal spot on the anode during operation of the x-ray tube,
a cathode front member having an aperture defined by the cathode front member on a first side of the emitter, and
a backing disposed on a second side of the emitter and connected to the cathode front member via a backing insulator, wherein the cathode front member and backing are independently biased to shape and accelerate the electron beam and guide the electron beam to the focal spot on the anode.

[c13] 13.The method as claimed in claim 12, wherein said cathode backing has a bias of Vbacking, said aperture of said cathode front member is biased at Vaperture and said emitter is biased at Vemitter, and Vback < Vemitter provides for a larger beam compression ratio than when Vback ≥ Vemitter.

[c14] 14.The method as claimed in claim 13, wherein gridding is accomplished when Vemitter > Vaperture for reverse biasing.

[c15] 15.An x-ray tube cathode comprising:
a cathode assembly opposing an anode and spaced apart therefrom, the cathode being maintained during operation of the x-ray tube at a negative

potential with respect to the anode, the cathode assembly comprising;
an emitter situated therein for emitting an electron beam to a focal spot on the anode during operation of the x-ray tube,
a cathode front member having an aperture defined by the cathode front member on a first side of the emitter,
a backing disposed on a second side of the emitter operably depending form the cathode front member via a backing insulator, wherein the aperture of the cathode front member and backing are independently biased to shape and accelerate the electron beam and guide the electron beam to the focal spot on the anode.

[c16] 16. The x-ray tube as claimed in claim 15, wherein the emitter has an approximately planar emitting surface.

[c17] 17.The x-ray tube as claimed in claim 16, wherein the emitter is a coiled filament.

[c18] 18. The x-ray tube as claimed in claim 16, wherein the emitter is one of a ribbon emitter, a dispenser cathode, an e-beam heated emitter and a field emitter.

[c19] 19. The x-ray tube as claimed in claim 17, wherein the coiled filament includes at least one of a straight section in said coiled filament, increasing the length of said coiled filament and increasing the diameter of said coiled filament for providing a larger emissive area to increase the electron emission.

[c20] 20. The x-ray tube as claimed in claim 15 wherein a potential difference between said backing and said aperture provides a larger beam compression ratio when $V_{backing} < V_{aperture}$ relative to when $V_{backing} \geq V_{aperture}$.

[c21] 21. The x-ray tube as claimed in claim 15 wherein gridding is accomplished by applying said independent bias at $V_{emitter} > V_{aperture}$.

[c22] 22.The x-ray tube as claimed in claim 15 further comprising at least one intermediary electrode member having an aperture defined by the at least one intermediary electrode member, the at least one electrode member disposed

between said cathode front member and said backing, the at least one electrode member configured to flexibly shape the electron beam emitted from the emitter.

[c23] 23.A cathode for x-ray tube comprising:
a cathode assembly opposing an anode and spaced apart therefrom, the cathode being maintained during operation of the x-ray tube at a negative potential with respect to the anode, the cathode assembly comprising;
an emitter situated therein for emitting an electron beam to a focal spot on the anode during operation of the x-ray tube,
a cathode front member having an aperture defined by the cathode front member on a first side of the emitter,
a backing disposed on a second side of the emitter and operably connected to the cathode front member via a backing insulator, and
a means for applying a differential bias in the cathode to variably change the focal spot size.

[c24] 24.The cathode as claimed in claim 23 wherein the means include having the cathode front member, and backing being independently biased to shape and accelerate the electron beam and guide the electron beam to the focal spot on the anode.

[c25] 25.The cathode as claimed in claim 24 wherein said cathode backing is biased at Vbacking, said aperture of said cathode front member is biased at Vaperture and said emitter is biased at Vemitter, and Vback < Vemitter provides for a larger beam compression ratio than when Vback ≥ Vemitter.

[c26] 26.The cathode as claimed in claim 25 wherein the means allows for gridding accomplished by reverse biasing when Vemitter > Vaperture.

[c27] 27.The cathode as claimed in claim 23 wherein said emitter is configured providing a larger emissive area to increase electron emission from the emitter.

[c28] 28.The cathode as claimed in claim 27 wherein said providing a larger emissive area includes at least one of a straight section into a coiled filament, increasing the length of said coiled filament and increasing the diameter of said coiled

filament.

[c29] 29.The cathode as claimed in claim 23 further comprising at least one intermediary electrode member having an aperture defined by the at least one intermediary electrode member, the at least one electrode member disposed between said cathode front member and said backing, the at least one electrode member configured to flexibly shape the electron beam emitted from the emitter.